HUMAN RESOURCE ISSUES AND THE SUPPLY OF SCIENCE AND TECHNOLOGY WORKERS IN PUBLIC SECTOR LABS

The Impact Group

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In accordance with the Council of Science and Technology Advisors' (CSTA) requirement, our survey of countries within the OECD group examined several discrete issues having to do with the supply of highly qualified personnel in the S&T sector. Those issues can be summarized as:

- The premise of shortage caused by demographic and occupational trends;
- The nature of HR strategies – or lack of it – regarding S&T employee recruiting;
- Recruiting strategies;
- Retaining skilled workers;
- Reskilling (rejuvenating) the existing S&T workforce.

Under these headings, we attempted to discern specific actions which organizations had taken to assure a future supply of S&T workers. For example:

Recruiting strategies:
- entry level recruiting strategies;
- recruitment of personnel in mid-career;
- partnerships among universities, agencies, private sector firms;
- conditions of hiring.

Retaining workers:
- initiatives to retain skilled personnel
- flexibility and retention
- opportunities on the job.

Retiring workers:
- deploying the skills of retired/retiring personnel;
- planning for knowledge transfer from retirees to new hires;
- how organizations deal with the transition to retirement.

We attempted to break these factors into component parts. However, it was often difficult to separate them. In Japan and Germany, for example, issues of tenure and seniority prevent retirements while blocking the hiring and promotion path for younger recruits while reducing retention rates. Both countries are dealing with this issue. Meanwhile, the U.S. federal lab system (notably the Department of Energy) operates a seamless hiring and mentoring system that keeps senior people coaching the young, while enjoying the benefits of joint faculty and lab appointments. Interchange between university and lab appointments is encouraged.

THE UNITED STATES

THE FEDERAL LABORATORY CONSORTIUM
RESPONDENT: CHAIR OF FLC AGENCY REPRESENTATIVES, DAVID APPLER (March 13, 2002)
DEFENSE TECHNICAL INFORMATION CENTER

Demographics: "Yes, demographics are against us. Fifty percent of federal workers are set to retire in the next five years. That includes S&T personnel."

Hiring and retention: Rigid pay and benefit scales in the US civil service created a salary cap for senior people, with salary compression behind the top earners. The US has a particular disadvantage in this respect: no civil servant may earn more than a member of Congress. This rigidity has been overcome in certain areas. The government must look, and is looking, for ways to reward good people apart from financial benefit. Several agencies are moving to implement reforms that are working in successful cases, such as the Department of Energy (cf.) and its Sandia Lab (cf.). In the DoE specifically, S&T workers are effectively de-linked from the strictures of federal civil services employment (cf. DoE, Mrs. Toni Joseph).

OFFICE OF PERSONNEL MANAGEMENT
RESPONDENT: PERSONNEL MANAGEMENT SPECIALIST RON PAISTE (March 13, 2002)

Demographics: The enormous problem with demographics in the S&T sector was effectively hidden during the '90s by government downsizing. Now we are seeing much more than the "tip of the iceberg": the whole scope of the problem stands revealed.

Hiring and retention: The continuing threat of downsizing and talk about "big government" in the United States is not a solution to "recruiting the right people from universities, let alone creating a climate in which to retain them." In general terms, it is still difficult to recruit engineers into federal government agencies.

Recruiting and retaining: The government recognizes the problem (cf. Congressional hearings). But the government, and some agencies, have been slower to act. The US government continues to experiment with "student loan partial reimbursement" programs, whereby hiring agencies pay part of a graduate's debts. (The State Department, as well as S&T employers, is doing this.) The inflexible pay scales of the civil service are breaking down. We have in place "above minimum hiring rates" for "people with rather outstanding qualifications." The Office of Personnel Management has listed "special salary rates for IT workers" since 1999. "We deemed this program successful: it was even more successful after the dotcom crash." OPM is seeking congressional sanction to extend this program to S&T workers outside the IT sector.

"THE NATIONAL SECURITY IMPLICATIONS OF THE HUMAN CAPITAL CRISIS"
CONGRESSIONAL TESTIMONY TO SENATOR DURBIN'S COMMITTEE,
"THE OVERSIGHT OF GOV'T MANAGEMENT, RESTRUCTURING SENATE COMMITTEE…
AND THE SUBCOMMITTEE ON CIVIL SERVICE AND AGENCY ORGANIZATION
OF THE COMMITTEE ON GOVERNMENT REFORM HOUSE OF REPRESENTATIVES"
(March 29, 2001)

Demographics: In January 2001, "[General Accounting Office] GAO designated strategic human capital management across the federal government as **high risk**." GAO has an ongoing study "to examine human capital challenges." The GAO Commission reports (in the interim) that "we look upon the recruitment and retention of talented people as a principal problem of the Federal Government." An exchange of views during testimony at the Committee reads as follows:

Strategic planning: Addressing the Committee, Mr. Henry "Butch" Hinton, Managing Director, Office of Defense Capabilities and Management at the US General Accounting Office, said: "Action is needed. It begins with strategic planning. Human capital needs to be viewed from a strategic standpoint across the government. While Defense and State have taken action, a lot more needs to be done, and we are willing to work with you, Mr. Chairman, to get on a path for a solution to addressing those problems."
Hiring: Mr. Hinton said, "We recommend three things: first, changes in the form of compensation; second, flexibility [in terms of engagement] and flexibility goes with compensation; third, education and training. That is a form of compensation."
Education: Senator Durbin commented, "… part of the recommendations that come from the Commission we are considering suggest that we **need to talk about education in this country anew** and how we increase the workforce of America in critical areas, not just obviously to serve the government needs – that is the nature of this hearing – but to serve our Nation. I think, frankly, that some of the recommendations are exceptional. In fact, I have gone so far as to incorporate them in **proposed legislation that parallels the National Defense Education Act, known as the National Security Education Act**. It goes particularly **in the area of math and sciences**, but beyond, to try to find ways to help young people move in the right direction, toward careers that are not only fulfilling to them but that we can help them attain." [*Emphasis added*]

US DEPARTMENT OF TRANSPORTATION
LYNN MURRAY, CHIEF, COMMUNICATIONS AND TECHNOLOGY OUTREACH (March 13, 2002)

Demographics: "[CSTA's] premise is correct. It is becoming more difficult to recruit and retain skilled S&T staff to public labs." Of 700+ labs in the US federal system, certain labs are challenged more than others.

"Hiring" by linking: The US Department of Transportation operates a Laboratory Locator URL, currently being upgraded. This helps private companies and the appropriate labs. to locate each other. The aim is that each party can borrow and trade expertise from the other in the development of shared projects. This does not, however, assist in primary hiring or retention.

PAY COMPETITIVENESS & QUALITY OF DEPARTMENT OF DEFENSE SCIENTISTS & ENGINEERS
A REPORT FOR THE OFFICE OF THE SECRETARY OF DEFENSE,
NATIONAL DEFENSE RESEARCH INSTITUTE, RAND
BY MICHAEL GIBBS

This lengthy report concludes:

- Science, Engineering and Technology workers are becoming more important in the national and Department of Defense (DoD) workforce;
- Federal pay systems have not evolved sufficiently over time;
- Productivity (per pay) declined in DoD labs. to 1996 compared to private sector;
- It is possible that DoD has difficulty recruiting, retaining scientists and engineers;
- Scientific and Engineering personnel (S&E) working in defense switch between DoD and contractors regularly;
- This suggests an "important element" of defense-industry-specific human resources;
- High-quality S&E personnel stay with DoD because they "match the work environment";
- In consequence, high-quality S&E are "less-elastic" to lure of private sector;
- In DoD labs, "merit" and "flexible" pay schemes did not improve the workforce;
- Flexible pay systems did not help DoD recruit or retain technical employees;
- Pay comparability is not simply about the level of pay;
- Pay *structure* and promotional paths outrank pay levels in *retaining* staff;
- Pay systems must reward skills and "other dimensions of quality and performance".

US DEPARTMENT OF ENERGY
OFFICE OF PROCUREMENT AND ASSISTANCE MANAGEMENT
STEPHANIE WEAKLEY, LEADER, CONTRACTOR HUMAN RESOURCES MANAGEMENT TEAM
March 18, 2002

Demographics: "The Department of Energy (DoE) has been challenged to find people to go into pure research."

Hiring: Extensive study has preceded staffing DoE energy research facilities. "One way to get the right people to work for our contractors is to build collaborative ventures. People take leaves of absence from a 'parent' employer with no loss of seniority, salary or pension rights."

After years of not hiring, DoE faces a challenge "filling the pipeline again" especially given demographic trends. So, DoE is going through extensive "**tactical maneuvers" to share key staff** within the contractor system. Current work on the Spallation Neutron Source at Oak Ridge TN, borrows from Los Alamos, Brookhaven, Argonne and Livermore, and several universities.

Retention, Reskilling: The fact that people may work on many projects, including Spallation, gives them variety while "maintaining a collegial approach." Meanwhile they lose no financial, pension or tenure status. They do not become civil servants. Oak Ridge, or the DoE itself, could not afford (or be allowed) to pay pensions on the scale of the University of California. (cf. DoE, Mrs. Toni Joseph). The department essentially hires – or rather, their contractors hire – people as visiting experts. "We have to maintain all kinds of 'recognition mechanisms' but the effort wins, and keeps, good S&T people." This "**flexible access to just the right people**" helps the government retain their services.

HR Database: DoE maintains an excellent database on who does what, where, and for whom.

US DEPARTMENT OF ENERGY

OFFICE OF SCIENCE EDUCATION

Motto: "The U.S. Department of Energy is committed to helping educate our nation's next generation of scientists."
(http://www.scied.science.doe.gov/scied/sci_ed.htm)

The U.S. Department of Energy is committed to helping educate our nation's next generation of scientists.

Check out these **online resources** for K-12 educators.

http://www-ed.fnal.gov/doe/doe_labs.html

Each site has its own link leading to the relevant online resources for K-12 teachers.

US DEPARTMENT OF ENERGY
DIRECTOR, LABORATORY POLICY & INFRASTRUCTURE MANAGEMENT, MRS. (TONI) JOSEPH
March 27, 2002

Demographics: Great concern about an ageing workforce. Estimates that 50% of S&T employees are "nearly eligible" to retire. But DoE has several initiatives under way.

Hiring and retention within the Agency: A "Human Capital Initiative" is DoE-wide. DoE has permission to hire top people in the agency for: basic energy sciences, fusion, biology, environmental research, scientific computing, hi-energy and particle physics, and nanoscience. These are "accepted service" people, put on a faster track than normal civil servants. However, the vast majority of the tens of thousands of S&T personnel working on DoE projects *do not work for the agency*. They work for agency contractors, and are therefore not classified as civil servants. This flexible approach to staffing includes the S&T roll call of DoE's 27 major labs.

Hiring and retention in the labs: All labs are operated under contract by universities, corporations or non-profits. Therefore **all lab-based S&T personnel are employees of other organizations**. The labs. themselves are referred to as "GOCOs" (Government Owned Contractor Operated Laboratories). DoE dictates the research agenda: the work is done under the management of the appropriate contractor or consortium. Paychecks at Lawrence Livermore, for example, are written by the University of California. Employees therefore enjoy among the best pay and pension benefits in the country. "It's a much stronger attraction than being a 'civil servant' although you are in effect working for the federal government." University-contractors – U Cal, Chicago – use joint faculty appointments, which are very attractive to bringing the best people to the lab.

Hiring and retention in the labs, II: The large DoE labs are stocked with scientific equipment which even large universities cannot afford. (This point was made often in Canadian CFI applications. Principal investigators all over Canada were quick to stress that "you can't hire or hold first-rate people with third rate equipment.")

Hiring – the education pipeline: DoE starts paying attention to the best and the brightest in their undergraduate years.

The "Retention focus": The labs take undergrads in the summer. Many of these work at the same lab (on different projects) in their three undergraduate summers. Typically, an older scientist works as a mentor. "**There is a key period in freshman and sophomore years when these students get real hands-on experience. We find we are able to keep a large number of these students in the pipeline** compared to those who lack this hands-on experience." And it's simply because they are engaged in practical work, surrounded by senior people and state-of-the-art equipment and "doing real science." They return as grad. students and about 30% stay in the

pipeline and work for the lab. The younger ones see summer work as an investment in their future. It's like an internship, and it's highly valued by universities and their students.

Critical skills programs: DoE gives all labs dedicated funds for "critical skills programs."

Educating teachers: DoE now brings science teachers into the labs. as interns in much the same way as it imports summer undergrads. "We give science teachers hands-on research experience, so they can develop curricula, the better to teach those students who drop out from science in high school."

Women in the S&T workforce: A partial answer to the high [higher than males] dropout rate among qualified women is simply to put day-care centres on site. "This really did make a difference in retaining women."

Department of Energy overview: "All our labs operate initiatives for recruiting and retention. We have found that retaining can be as hard as recruiting. All labs have very good retraining and continuing education programs."

Reskilling: Extensive, annual focus groups with S&T workers in DoE labs – with their managers excluded – found that training and retraining were processes intrinsic to a varied work environment. **Retraining was essentially equivalent to the concept of working in a multi-disciplinary team, and moving from one project to another**. S&T workers themselves believed that prevailing working conditions and culture kept them interested, trained, retrained, and fresh.

US DEPARTMENT OF ENERGY
SANDIA LABORATORIES (DOE'S CONTRACTOR-OPERATOR IS LOCKHEED MARTIN)
MS. BJ JONES, MANAGER, WORKFORCE MANAGEMENT, PLANNING AND STAFFING
April 2, 2002

Demographics: "The demographic bulge is a great concern for us. But, in common with the whole DoE system, we are actively planning our HR future. Being staffed with scientists and engineers, we have used them to statistically study this problem all different ways. We have done attrition modelling and retirement modelling to tell us what critical skills we may be losing." Such studies underpin Sandia's workforce planning; they let the lab take "a strategic business look" at the possible gap between skills, trained personnel and funding over the next decade.

HR churn seen as opportunity: This modelling has allowed Sandia to study the skill sets it will need three to five years on: namely, microsystems people and nanoscientists. Sandia asks: are these news skills, or are these replacement skills? (cf. Vitesse, Ottawa.) This kind of gap analysis

gives very practical forecasts. Sandia practices a high level of "knowledge management" to identify skills needs and impending shortages.

Hiring, Reskilling and retaining: Having done this homework, Sandia is developing a clear understanding as to how it should move forward with plans for: reskilling the incumbent work force; **building a "strategic pipeline of tomorrow's talent" by using student internship programs** "very robustly"; focusing on certain areas (i.e. microsystems, nanoscience). Not many undergrads. are in these pipelines right now. So Sandia intends to steer them via summer internships and the facilities they will need to get advanced degrees. "Five years from now we see a viable future of regular employees in this field."

Critical skills programs: DoE gives all its labs special funds for "critical skills programs," to create the people with the critical skills the agency needs for tomorrow. In a few, very specific cases – manufacturing technology, photonics – Sandia works back through the University of Albuquerque and a local technical college, right back to a targeted high school. Here, Sandia works to **funnel students into the appropriate educational environment**: they work at Sandia in the summers. Then they graduate with the skills that Sandia is looking for.

Creating its own pool: Sandia needs the best and the brightest with advanced degrees to work on classified projects – and they must be US citizens. The pool is dwindling. "We have to create our own pool."

Educational outreach program – web sites: These reach into a lab's local community to do educational outreach programs (cf. BHRC). This pays off to a degree: of 500 hires each year, "We know that 16% were 'with us in the past' in some capacity." It is anticipated that when these "pipeline programs" mature, a figure of 30% to 50% is not an unreasonable expectation. It is much easier to identify a promising student, work with him or her through the summers, and help with grad. school than to walk onto a campus in a cold-call setting. "**Efficiency of recruiting is much better when you groom them than when you cold-call find them**."

Hiring – Forming strategic partnerships with select universities: To put this sort of bottom to top recruiting approach into effect, Sandia is forming strategic partnerships with individual faculties for collaborative research, so that faculty members become partners, helping to identify top students. It is similar to "growing our own" through the student programs. We build on an established relationship with a university that can serve as a pipeline for talent.

Reskilling and retaining: Sandia calculates a "total reward" package that is much more than pure pay. It takes into account benefits and continued/continuing opportunities for reskilling and development: flexible work environment, the quality of colleagues. This helps the lab to understand what keeps people at work. (Current attrition rate, excluding retirees, 2%.) "But we need to keep an eye on it!" "Something is working" about the total reward package, work

environment, etc. (At Sandia, patriotism is an issue, too.) Sandia bills itself as a "learning organization" where an employee can have "thirty different careers without having to leave this company." Sandia will pay for an employee's advanced degree: but Ms. Jones considers that the **informal conditions are perhaps more important in retaining S&T staff**. Furthermore, Sandia has a training and development system that supports continuous learning.

Knowledge-gap management: Sophisticated studies in knowledge-gap management identify key skills needs. For example, Sandia now has a two year intern program in "Weapons work" where existing employees study this critical field. "We have a very scheduled, robust program for this sort of lateral transition" (cf. Vitesse.)

NASA
GENERAL (RET'D) SPENCE (SAM) ARMSTRONG (March 15, 2002)
SENIOR ADVISOR TO THE ADMINISTRATOR

Preamble from a NASA white paper: "In February 2000… it was announced that NASA would begin hiring again, and this suggested that improved cooperation with universities could be of assistance in recruiting the best and brightest talent to enhance the NASA workforce.[1]

Demographics: NASA shares the view that the best and the brightest are becoming harder to lure into government-driven S&T. High level meetings with the Department of Energy resulted in NASA basing aspects of its S&T HR policy on the example set by DoE (cf.). A study by the Government, University, Industry Research Roundtable (*Future National Research Policies Within the Industrialized Nations: Report of a Symposium*, 1992, ISBN: 0309046424) concentrated on the Science and Engineering workforce for the next decade. It found that, in a growing national population, the absolute number of graduates in the physical sciences dropped 4% in the past two years. Furthermore, many foreign graduate students are now returning to their countries of origin to serve their own growing university systems.

"Hiring" through cooperation: General Armstrong commented that "Because of the past hiring freeze, our hiring skills are atrophied." Rather than hire outright in a difficult market, NASA is actively rebuilding its policy of cooperation with universities. "This urgency necessitated a sampling technique of universities… The challenge was to identify partnerships and cooperation that presented the greatest win-win opportunities for everyone for these additional resources." Sampling revealed six major themes.[2] (*Roman numerals match the original white paper.*)

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[1] NASA White Paper: *Enhancing NASA/University Cooperation*, March 2001.
[2] Ibid, page 2.

I. Increased dialogue and interaction between NASA, colleges and universities in all areas of research… should enable innovation… and introduce new people and institutions to NASA.

II. NASA should sponsor longer-term research projects to give universities planning assurance and allow them to establish resources [capital and HR] to attack more difficult research projects. This about-to-be-announced Ready Research Engineering Technology Initiative is based on programs from the National Science Foundation (NSF) and the National Institute of Standards and Technology (NIST).

III. NASA will word its research contracts to insist upon mandatory inter- and cross-disciplinary research in and among universities working on NASA projects.

IV. NASA will simplify the procedures, contractual and legislative, to make collaboration with NASA more friendly.

V. NASA will collaborate with other government research agencies to "leverage taxpayer dollars sent to universities."

VI. Improved NASA/university cooperation will create a recruiting conduit. For example, by exposing "talented young people to the excitement of participating in NASA's missions." This, comments the white paper, may be the **best way in which NASA can compete "in today's tight job market**." [NASA will insist on vertical integration from student level up in contracts. NASA will be more active in supplying career centers with materials.]

NATIONAL ACADEMY OF SCIENCES (NAS)
GOVERNMENT-UNIVERSITY-INDUSTRY RESEARCH ROUNDTABLE (GUIRR)
EXECUTIVE DIRECTOR, MERRILEA MAYO

Demographics: Government agencies and labs. are keenly aware of this. The DoD is anxious about the problem of the demographic turndown and the lack of S&T personnel coming up.

But *industry* in the United States has not grappled with the problem at all (with notable exceptions), except to lobby Immigration for H1B visas in order to import more overseas talent. "This [H1B visas] is a huge issue in the US." There is a cap on how many can be issued, and industry is lobbying for the number and periods of these to be raised. "Only now is industry beginning to develop the faintest groundswell of appreciation" that the coming drop in S&T personnel is a national problem. In as much as there is a lobby to obtain more personnel, business's threat to government goes something like this: "If we don't train more here, we will shift production overseas."

"One of the things that the people at NAS are most concerned about is that **nobody else seems to be concerned** about it!" Graduates in core sciences have dropped by 10% to 20% in the last ten years. "We are about 20% below where we were in 1985-6."

"The people with the *worst problem* [re S&T HR] is the DoD. [DoD must employ US citizens.] The people *working hardest* on the problem is the National Science Foundation." NSF considers it part of its mission to help solve this problem. The *Intergovernmental Personnel Act* (IPA) allows the NSF to borrow people from many different places, but the NSF is concerned that this is not enough (cf. Mary Burke, NSF). IPA allows some short-term solutions, but does not change the fact that there is a shortfall of recruits to the sciences (from high school onwards).

The Department of Education and the NSF have so far spent 1$ billion each on this S&T workforce issue, to date: "trying to get technically-talented people to grow up in the United States – and it's a problem."

Interest in the sciences by students and undergraduates is "hugely connected" to levels of funding which the government puts into various sectors. The government's *incremental* raise to the National Institutes of Health (NIH) this year [2001-2] is equal to the whole budget of NSF, which looks after everything else. This bias to the life sciences has been consistent for the past five years – and it reflects at the university level, where all new infrastructure goes into the life sciences, "whereas the physical sciences are basically dying." The graph of new B.Sc. degrees in different sectors closely follows the government's funding bias, because universities rely on that funding to make up the cost of providing education in technical disciplines. "That is why we have had such a huge problem."

NATIONAL SCIENCE FOUNDATION (NSF)
INTERGOVERNMENTAL PERSONNEL ACT (IPA)
MARY BURKE, IPA ADMINISTRATOR

Hiring by borrowing: The IPA Act allows NSF to borrow top-echelon researchers from their home institutions and work on projects within the ten NSF Offices and Directorates. (The figure below shows nine out of ten. The chart does not capture the tenth, the Office of Polar Studies.)

Currently, 143 senior S&T people are enrolled as "IPAs" to the NSF, the largest number to date. They are on loan from their home institutions from a period of two or three years (rarely, one year or four). During that time, the NSF reimburses their home institutions for their salaries and the loss of their services (and reimburses the IPAs themselves for the loss of consulting services during the term of their service to NSF). IPAs retain seniority in their home institutions. As such, they do not become civil servants, and therefore do not incur the inflexibilities of civil service pay and grading system (c.f. DoE.)

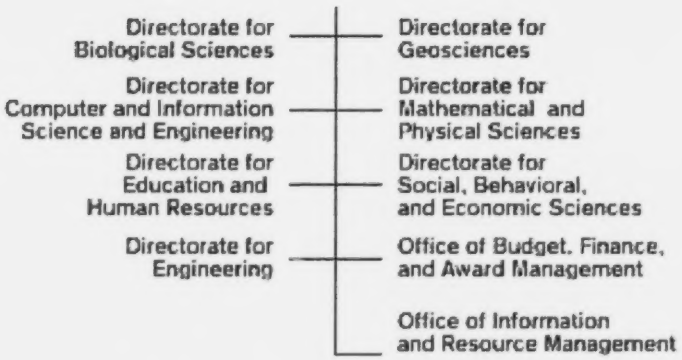

Directorate for Biological Sciences
Directorate for Computer and Information Science and Engineering
Directorate for Education and Human Resources
Directorate for Engineering
Directorate for Geosciences
Directorate for Mathematical and Physical Sciences
Directorate for Social, Behavioral, and Economic Sciences
Office of Budget, Finance, and Award Management
Office of Information and Resource Management

Figure: Directorates of the National Science Foundation
Source: http://www.nsf.gov/home/chart/orgchart.htm

REPORT: "IMPROVING RECRUITMENT, RETENTION AND UTILIZATION OF FEDERAL SCIENTISTS AND ENGINEERS"
OFFICE OF SCIENTIFIC AND ENGINEERING PERSONNEL (1993, 2000)
(http://books.nap.edu/books/0309048494/html/17.html#pagetop)

This report examines the mechanisms or combinations of mechanisms for conducting federal science and technology-related work that could be used more widely **to enhance recruitment, retention, and utilization of federal scientists and engineers**. The report also addresses questions of organizational responsibilities for implementing changes that would give the government more flexibility to recruit and retain well-qualified scientists and engineers and the types of data and analysis needed to monitor the effectiveness of the system.

Demographic: "The federal government is the largest single employer of scientists and engineers in the United States. Approximately 223,000 federal employees are engaged in a wide variety of scientific and engineering occupations in every department and agency. Together they constitute more than 13 percent of the federal civilian white-collar workforce (NSF, 1991; OPM, 1989f). The government is involved in the conduct and support of scientific discovery and technological progress because science and technology (S&T) are critical components of the nation's economic growth, national security, public health, environmental safety, and other aspects of the public welfare."

Key conclusion in this 90 page report recommends that Congress and the President set up an office called the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). FCCSET would be chaired by the Office of Science and Technology Policy in the Executive Office of the President, which is also the President's science advisor. Additional recommendations are:

Recommendation 1. The pay reform provisions and related flexibilities provided by the Federal Employees Pay Comparability Act (FEPCA, 1990) should be **implemented as fully as possible by... departments and agencies, to redress pay inequities and reward superior performance among all federal employees, including scientists and engineers**.

The Office of Personnel Management's (OPM) responsibilities would fall under...
Recommendation 2. OPM should follow its aggressive effort to delegate its authorities under FEPCA with an equally strong effort to see that FEPCA authorities and flexibilities are decentralized to the appropriate levels within departments and agencies.

Recommendation 3. To help carry out its responsibilities for encouraging, assisting and overseeing the departments and agencies, OPM should **develop an organizational focus for science and engineering personnel policy staffed by individuals who have had experience as senior managers of scientists and engineers**.

Departments and Agencies would be responsible for...
Recommendation 4. **Each federal agency with a science and engineering workforce should develop a comprehensive action plan**, with assistance from OPM, to (1) identify agency goals and develop an appropriate science and engineering staffing plan, and (2) use the authorities provided under FEPCA to improve recruitment, retention, and utilization of scientists and engineers.

Interagency coordination would be responsible for...
Recommendation 5. A new **interagency committee on federal scientific and engineering personnel should be established in the Executive Office of the President** under FCCSET to (1) evaluate and recommend science and engineering personnel policies and their implementation; (2) develop model strategies for combining the relevant flexibilities in FEPCA and for science and engineering personnel program evaluation; (3) share successful and unsuccessful experiences; (4) monitor the overall success of the government in recruiting and retaining scientists and engineers across agencies; and (5) provide a forum for identifying and working out solutions to common problems.

Congress and the Executive Branch would be responsible for...
Recommendation 6. Congress and the Executive Branch should work together to make further changes in the civil service system that address the problems beyond pay flexibility per se. Meanwhile, Congress and OPM should continue the personnel demonstrations as testbeds for policies and practices not necessarily permitted under FEPCA or other federal personnel laws.

General conclusions:

"... Scientists and engineers are motivated to **enter and stay in federal service** by a number of nonpay factors, such as the **opportunity to identify and develop the solutions to important national problems**, the satisfaction of **conducting scientifically important research** and **managing large-scale engineering projects**, the **quality of the facilities and equipment in federal labs**, and the **opportunity to engage in long-term projects**. In order to attract and retrain talented scientists and engineers, and increase their productivity, the federal laboratories must have **adequate technical and support personnel** and **up-to-date equipment** and facilities comparable with those available to their professional peers in other research settings." [*Emphasis added.*]

JAPAN

INFORMATION DERIVED FROM

- THE (NEW) BASIC PLAN

- DFAIT'S NORIKO ABE, TOKYO

- DR. YUKINOBU MIKI, SENIOR PLANNING OFFICER, AIST

- (US) NATIONAL SCIENCE FOUNDATION, TOKYO, MEMO #01-04

- NEWS REPORTS.

Demographics: Japan is more keenly aware of demographic trends than any other OECD country – its low birth rate makes Japan very vulnerable. At the other end of the spectrum, the job-for-life culture continues to make it difficult for young graduates to advance within university faculties. This is changing. A Cabinet Decision of March 30, 2001, rewrote "The Basic Plan for Science and Technology." At first glance, this revolutionary policy appears to have more to do with administration of S&T than with human resources. However, aspects of major restructuring permits easier entry and promotion of S&T personnel within the system.

Japanese conditions: Before discussing the Basic Plan, it is important to note societal habits which this plan seeks to change. The National Institute of Advanced Industrial Science and Technology (AIST) has traditionally hired about 100 postdocs. each year whose average age is 30. When they complete a contract at AIST (not fixed term), they seek to stay at AIST on permanent staff. AIST has in the past encouraged them to move on, but they claim "they cannot find better positions than AIST in light of various working conditions." Since the retirement age at AIST is 60, these people begin to migrate to university faculties in their mid-forties, to get employment until the university retirement age of 65. Therefore many universities have tended to hire staff into middle and senior faculty positions, blocking promotion from below.

One problem of the "old" way of doing business in Japanese S&T was that government labs. and agencies did their work, but private corporations seldom picked up on the results. From the point of view of AIST, the government provided funds whether the research was transferred or not. That was the "old" AIST. The "new" AIST – (Japanese documents use the descriptors "old" and "new") – will also be funded by government, but AIST research projects will be evaluated regularly and funding cut off if results, or external interest, is not promising.

AIST is the largest among some fifty-five Independent Administrative Institutes (IAIs). It employs 3,200 S&T personnel. Reform of the whole delivery and management of S&T in Japan was imposed from Cabinet level, reflecting the urgency with which the government views the "brain drain." That phrase does not occur frequently in the Basic Plan, but it is a major consideration. Other considerations deal with the tendency of senior people to block the path to promotion; to take credit as principal investigators while the talents of postdocs. remained obscure and – until recently, unrewarded – and the commensurate shortage of a/ available places in the S&T pipeline, and b/ the lack of incentive to stay.

Headings from Section II of "The Basic Plan" give an indication of **directions in which HR policies are shifting** in tandem with the major upheavals in the institutional structure. Section II, "**S&T System Reforms to Create and Utilize Excellent Outcomes**," lists the following objectives:

- Arrangements [to create] a Competitive R&D environment;
- Improvements in HR liquidity through proliferation of fixed-term system;
- Improvements in young researchers' self-reliance [and self-esteem];
- Reforms on the evaluation system;
- Elastic/effective/efficient management of the system;
- Application of able persons and development of various career paths;
- Realization of the system of creative R&D.

Thus it can be seen that *HR reform* is part and parcel of a total *institutional reform* in charting, planning, funding, execution and outcomes of Japanese public sector S&T research. "Excellent young researchers" – an oft-repeated phrase – become an integral part in a new implemented policy for S&T which previously worked only from the top down.

- Competitive funds: "Our goal is to double the competitive funds made available during the period of the second basic plan" [to 2011]. This policy specifically acknowledges effectiveness of competitive systems in the United States.
- Funds will no longer be awarded to a single researcher, but only to principle investigators who demonstrate full participation of post-docs and graduate students. ["Group study" is the appropriate term.]
- Research projects, as noted before, will be subject to "intermediate" evaluation [at three years and above. No subject will be allowed to run past five years without extensive evaluation].
- These evaluations will be made in such a way that the contributions by "excellent young researchers" will be evaluated as discrete components of the whole. [In short, no more "Principal Author and everyone else." The evaluation process will evaluate not only the product, but the component contributions to that product by all members of a research team, so that "the associate professors and assistants can make full use of [showcase] their abilities in the R&D system."
- Institutes are now required to provide "necessary research space" so that "excellent young researchers" can do their work.
- In doubling competitive funds, "aggressive applications [by] young researchers should be encouraged in competition for these funds,"... "together with enlarging the research expenses [required] by "young researchers."
- Awards – not specified – will be forthcoming to "young researchers" who yield "particularly good results."

"The ten thousand person plan."
Although The Basic Plan recognizes that the majority of graduate students and post-docs. will work under the guidance of "research leaders," the plan will make specific provision for 10,000 post-docs. to embark on their own projects of study while they are working on their leader's project. During the first years of this program, results will be closely watched.

"Improvements in HR liquidity through widespread adoption of the fixed-term system"
The Basic Plan assumes that a period of fixed-term employment for graduates and post-docs. (to the mid-thirties), followed by tenured positions, "is the source of vitalization of the R&D environment in the US." The Basic Plan intends to implement this.

- Further, the Plan hopes to implement broad exchanges of S&T personnel among industry, universities and public sector facilities "so that researchers can obtain jobs commensurate with their natural endowment and capabilities." All public labs. are now required to adopt this system. These fixed terms may be raised from three years to five, depending upon project and performance reviews.
- Exchanges of S&T personnel among industry, universities and public sector facilities will also encourage overseas postings and administrative aspects of S&T work, so that "young researchers can measure up in the widest job field, such as administration and industrial areas, as well as R&D."

"Improvements in young researchers' self-reliance"

- As mentioned earlier, reviews will now evaluate projects so that the work of individual researchers is allowed to shine or fail – as distinct from the principal investigator being considered the sole expert on a team.
- Every attempt will be made to give "young researchers" a certain degree of independence, within research teams, and with respect to specific choice in research topics.
- Increased funds are made available for "enlargement of the opportunity" by senior researchers to secure post-docs' services. In essence, additional posts (at least ten thousand) will be created on the low to middle rungs of S&T research in Japan.

"Reforms of project [and personnel] evaluation systems"
In the new scheme of things, when junior members of research teams are assessed for their individual contributions to a team's effort. Reviewers are to take into account "esteem" for a [young] researcher's freedom, educational opportunities within the assignment, and so on.

- Agencies are now required to create and maintain comprehensive databases to assess the S&T HR base in each subject for the whole country.

Reforms with respect to "excellent foreigners," women, and career paths

It is now recognized that there is a need to invite "excellent foreigners" to participate in R&D "in public research organizations" in Japan.

- Foreigners are to be allowed to compete for research funding on equal terms with Japanese researchers. As a first shot in this direction, to let them compete on "an equal footing," they will be allowed to write grant applications to AIST and other Japanese funders in English.
- Agencies are required to provide "fulfilling environments" for women researchers. Of special importance, women will be encouraged to return to the workplace after childbirth. This may be done in various ways. Daycare (cf. Sandia Lab) is not specifically mentioned. However, allowing time-outs for childbirth, in effect extending a new mother's "fixed term" employment, will be mandatory. Mothers will also be encouraged to work from home where possible, and provided with the appropriate tools to do so.
- In the interests of "expanding opportunities," public and private agencies and firms will be eligible to receive public funds – "competitive funds" – to encourage them to participate in R&D and to employ highly trained graduates or post-docs. in doing so. This also makes way for the next crop of postgrads in the university system. [This is not a make-work project for which Japanese public spending has become infamous in recent years.]

Realizing the system of creative R&D

The Basic Plan calls for nothing short of a revolution in management. "It is necessary to have new ideas not bound by existing management." The intention is **to create Japanese public sector research organizations that can be compared "with European and American first-class R&D organizations**."

- Senior functions will be split. Administrators will no longer be in charge of R&D. Senior R&D personnel will manage R&D.
- Excellent researchers are to be sought out and employed.
- Foreigners are to be actively recruited.
- Industry participation will be actively sought in public sector R&D.
- English should be used in public sector labs.
- State of the art "international" facilities will be installed in order to encourage competitive R&D.

Realizing the system of creative R&D

The Basic Plan realizes that it has a major problem overcoming the *status quo* – not least, in the management of universities, which the plan calls "unsociable," and "stiff." Nevertheless,

universities are still required to play a central role in securing, training, and creating "new intellect." However, "regarding the actual function of universities in Japan, various problems [are] weakness of educational function in specialized fields." **Graduate schools are now ordered to develop and reform themselves into "footholds of... high-tech/original education and research."** Public [National] universities are now expected to raise the level of their education [and] research by seeking exchanges with industries and other research institutions. And, universities will be expected to become "the core of development in scientific techniques in the local area" – in short, centres of regional outreach. That, the Basic Plan makes clear, includes maintaining "excellent graduate schools." Private universities account for 80% of all university students in Japan. They are complimented on their role in the national effort. [The clear implication is that public universities have contributed less than their fair share.] Private universities may receive more funds under the Basic Plan.

National test result organizations...

...will be required to do systematic/integral research, centering on coordinating curriculum requirements with the needs of science and technology in Japan. Regional testers are also required to do the same, on a regional level.

- National testers are required to coordinate with universities and industry.
- Regional public research organizations are to coordinate with regional industries.
- The National Personnel Authority is to study HR flexibility issues in this area.

The New Basic Plan – some press attention

The idea of treating post-docs. as if they were significant players in S&T is – like other aspects of the new Basic Plan – revolutionary in Japan. So revolutionary, in fact, that *Nihon Keizai Shimbun* [Japan's Economics Newspaper] printed the following[3]:

> **Postdocs to be Treated just like Assistant Professors [Headline]**
> In an effort to foster researchers of world highest standard, MEXT (Ministry of Education, Culture, Sports, Science and Technology) will establish a system to treat postdocs just like assistant professors, which will enable postdocs to receive good remuneration and research funds. MEXT also believes that the new system will stop the brain drain to overseas countries. The new system will be called "Super Postdoc System" and target researchers in their late 20s and early 30s in all fields of humanities and natural sciences. If successful, the researchers will receive Yen 500,000 (ca. $4,000) of research support per month. The research grant will be separately provided through the Grants-in Aid as before, but the ceiling amount will be doubled to Yen 3 million (ca. $24,000) per year. When the research support and grant are combined, it is possible for them to receive Yen 9 million (ca. $73,000) per

[3] *Nihon Keizai Shimbun*, November 19, 2001.

year. This system will be launched in the next fiscal year, with 12 researchers to receive such funds in the first year.

Collaborative activities with private firms

Prior to these reforms, AIST researchers were restricted to working on projects assigned by AIST "at the discretion of their supervisor." This meant that, prior to the reforms, they were not always permitted to collaborate with private firms. This has now changed.

Office of Venture Business Assistance / Technology Licensing Organization

Technology transfer from the public sector has never been a strong point in Japan. Now, however, AIST has established this office to **promote the transfer of AIST-invented technologies** (and those of other government agencies). This is accompanied by modifications in the patent laws, so that **researchers will share in commercial benefits** of their research.

Law on travel expenses

Totally revised. The number and value of the (old) Science and Technology Agency Fellowships was severely limited, restricting overseas assignments of Japanese researchers, sometimes to just months in foreign labs. It also restricted their participation in overseas conferences. New, relaxed regulations "provide them with more opportunities to gain experience in international S&T practices."

The (US) National Science Foundation supports the reforms

The following is drawn from NSF (US, Tokyo office) "Report Memorandum #01-04"

"[AIST's objectives are] underlined by the successful recruitment of eminent scientists from outside the AIST system to head several of the research centers. For example Sumio Iijima of NEC, the discoverer of carbon nanotubes, will head the Research Center of Advanced Carbon Materials. Kotoku Kurach, Professor of Human Genetics at the University of Michigan, has agreed to return to Japan after 30 years to head the Research Center of Gene Discovery. Fu-Kuo Chang, an aeronautical engineer from Stanford University, will head the Research Center of Smart Structures. As a final, encouraging example of the new AIST's determination to give primacy to scientific as opposed to bureaucratic considerations, the Director of the new AIST's International Affairs Department and his three deputies are all working scientists or engineers drawn from institutes of the former AIST, rather than career bureaucrats from METI."

THE UNITED KINGDOM

REVIEW OF THE SUPPLY OF SCIENTISTS AND ENGINEERS
A SUMMARY OF THE RESPONSES TO THE JUNE 2001 CONSULTATION PAPER
SIR GARETH ROBERTS' REVIEW
better known as "THE ROBERTS' REVIEW" (FINAL DRAFT, APRIL 2002)

ADDITIONAL RESPONDENTS:
DR. NICK MUNN, ROBERTS' REVIEW TEAM
DR. PETA PASCOE, CHIEF SCIENTIFIC ADVISOR'S OFFICE

During the budget process of 2001, the government appointed Sir Gareth Roberts to "lead an independent review into the provision of skilled scientists and engineers in the UK," reporting back to Her Majesty's Treasury. Roberts filed a preliminary report in February 2002: the final was published in April, prior to the national Budget. The preamble to the Roberts' Review reads:

"Business, universities and **the public sector need to be able to recruit and retain skilled scientists and engineers to underpin R&D activities**. The Roberts' team interviewed respondents from industry, academia and the public sector."

From the point of view of CSTA's mandate, it must be noted that Roberts does not separate out problems specific to public sector agency laboratory facilities – notably the National Health Service, the Medical Research Council, Harwell and other nuclear facilities. Roberts' mandate is to seek ways to improve the supply of S&T personnel across the board.

This is consistent with "Science Strategy" promulgated by UK governments under Prime Ministers Thatcher, Major and Blair. The current iteration of UK government policy – "HM Treasury Science and Innovation Strategy 2001" – reads as follows: "Direct expenditure by HM Treasury on science, research and innovation is limited to a small amount spent on economic advice and analysis and statistics. It is the Treasury's role in the development of the economic framework policies to encourage innovation and maximise the benefits of scientific research to the wider economy that will have a greater impact than direct spending by the Treasury."

Thus Roberts does not single out public sector laboratories. He is at pains to point out that the UK is not yet in crisis. "Between 1995 and 1997, the UK produced more scientific articles per head of the population than the US, Germany, France or Japan." However, this "justifiable strong scientific and technical reputation" cannot sustain without shifts in emphasis in the national educational system.

The educational supply chain:
Many respondents to Roberts felt that actual shortage started in school, commenting on the national shortage of science and mathematics teachers, their pay levels being a special disincentive. Further, teachers should be encouraged in continued professional development, and businesses and universities should participate with schools to permit this (cf. Sandia Lab's teacher "intern" project). The UK's National Centre of Excellence for Science Teaching is currently being set up. Raising morale would improve teacher retention. The ability for teachers to spend time either in universities or business would both update their practical skills and boost morale.

Science teaching by non-science grads. was felt to be a large problem in failing to transmit "enthusiasm" and "spark" to students.

The demographic of high school teachers is considered as important a problem as the demographic of current and future SE&T personnel. Insufficient numbers are graduating in the sciences to replenish the ranks of retiring teachers, let alone other S&T needs. The problem is especially bad in physics. The situation resembles that in the U.S., in as much as absolute numbers passing high school matriculation courses in math and physics continue to fall. Respondents noted a "perceived decline" in the quality of "science, engineering and technology (SET)" students entering university, to the extent that some universities had lowered entrance levels to SET courses.

Student debt was noted as a significant disincentive to study SET in university. This is particularly so, since many SET subjects require a four year undergraduate program, as opposed to the UK standard of three years for most subjects in the humanities.

The poor quality of equipment in university labs. was a considerable disincentive to potential SET students.

Careers guidance at university level was found to be lacking for SET graduates. Roberts suggests that universities, industry and public sector employers of SET personnel should **re-examine the long-established but discontinued practice of "work placements."** These used to be called "sandwich courses," when students could spend whole university terms working in industry. This follows the apprenticeship examples long established in engineering companies, for which there is also new emphasis. A previous report to the UK government, the Dearing report, commented that "work experience made graduates more attractive to industry and that businesses often found work placements an effective recruiting mechanism." (cf. Sandia.)

It should be noted here that the Wellcome Trust is promoting "Vacation Scholarships 2002" "to provide promising undergraduates with hands-on experience of research and to encourage them to consider a career in research." Applications are invited from basic science, biomedical and

veterinary science departments for undergraduates to work on a research project during the summer vacation.

The drop in SET student numbers at undergraduate level is disproportionately larger at PhD level. The "relatively low level of the PhD stipend" works as a major disincentive for two reasons: because of unfavorable comparison with salaries in the working world, and because this further compounds problems of still-unpaid undergraduate debt. Further, the "relatively low level of academic salaries and the insecurity of fixed term contract work acted as major disincentives to embarking on a career" in teaching in higher education. Many current PhD candidates come from overseas, and return to their home countries. This "predominance of overseas students is a concern for the future… We are exporting our expertise to our future cost."

In this connection, Roberts reported favorably on the concept of "doctoral training accounts" which the Engineering and Physical Science Research Council (EPSRC) has introduced as a means of giving universities "more freedom" over the duration and amount of funding given to EPSRC postgraduate students.

It should be noted that the Wellcome Trust attempts to redress the shortfall of funds at student and postgraduate levels. "The purpose of the Wellcome Trust's Career Development Programmes is to provide opportunities, through fellowships and scholarships, for promising scientists to develop into highly skilled and independent research workers who can then make important contributions to the advancement of biomedical knowledge. The Trust has a portfolio of personal award schemes that provide salary as well as research support for individuals from the early (PhD) stages of their research career through to senior (professorial) academic level."

The marketplace for scientists and engineers

"The recruitment of postgraduate students, particularly in engineering and science disciplines, is becoming particularly difficult." **Low salaries paid by industry and public agencies contrasts to the higher fees paid by sectors such as financial services**. Meanwhile, short term fixed term contracts paid by R&D employers also act as a significant disincentive. This makes **careers in R&D "unattractive to women in particular."** Graduates desiring to stay in S&T rapidly formed the opinion that remaining in academia held out a better chance for a long term career than other options.

Many respondents to Roberts felt that universities lacked a communications framework with R&D employers. The process is currently "ad-hoc." Some respondents went so far as to suggest that "there should be a national forum to aid the process of communication between the various stakeholders." In this respect, Germany's Fraunhofer Institutes (cf.) were cited as a positive example.

The introduction of **R&D tax credits "could" improve demand for corporate R&D, and therefore have positive effects on the supply of good quality scientists and engineers. [Supply following money, at least at BS level, has been demonstrated in the U.S. (cf. Merrilea Mayo, NAS.)] This would ease supply to the public sector as well as industry.**

Retention: Roberts reports that working S&T personnel are quick to assess the fact that "the career path to **success is often seen as going into management rather than staying in science**." Some employer-respondents reported that they were attempting to eliminate this problem by offering a dual career path, allowing some freedom of movement between the two functions.

A national failure to understand the importance of science

Mrs. Toni Joseph (cf.), at the US Department of Energy, pointed out that British science had been privatized in two phases during the Thatcher years. In the first phase, private industry was invited into such facilities as Harwell; in the second phase, private industry took over much of the public sector investment in lab-based science. This in effect eliminated pure science in favor of technology transfer for profit. Roberts now echoes that comment: "R&D is sometimes seen as a drain on profits and is not valued as highly as it should be, leading one respondent to state, 'The problem may not be one of supply, but one of culture,' a failure to understand and commit to the link between innovation and performance."

Public perception

Roberts: "A conversion to a science-friendly society (which we do not have in the UK unlike the USA) would have a major impact on the whole science education chain."

Participation by women

Several respondents felt that "the gender imbalance could be attributed, in part, to short term contracts that are ubiquitous in research and the consequent lack of career security." Again, the German Fraunhofer Institutes (cf.) were held up as examples of how HR supply in S&T fields can be brought into line with research demands (by public labs and agencies as well as businesses).

"Coherent, structured action"

"Annex B" of the Roberts' Report reproduces a cover letter to the Chancellor of the Exchequer: "**Only through coherent, structured action throughout the supply chain for scientists and engineers, coupled with action by employers to improve the attractiveness of jobs in science and engineering, can the UK's future R&D and innovative performance be raised to match the world's best.**"

CREATING KNOWLEDGE, CREATING WEALTH
REALISING THE ECONOMIC POTENTIAL OF PUBLIC SECTOR RESEARCH ESTABLISHMENTS
A REPORT BY JOHN BAKER TO THE MINISTER FOR SCIENCE
AND THE FINANCIAL SECRETARY TO THE TREASURY (2000)

This report deals largely with technology transfer *from* Public Sector Research Establishments (PSRE), and wealth creation therefrom. However, in doing so, it *does* acknowledge that the optimal way to create (and share) the product of Her Majesty's Research Establishments is to **retain the S&T staff in place, by keeping them happy**. Chapter 6 of John Baker's report deals specifically with this issue:

> Chapter 6. Incentives for PSRE Staff:
>
> "6.1. Many scientists enter the scientific profession motivated by their passion for science and their desire to push forward the boundaries of human understanding. I have been impressed by the commitment demonstrated by the scientists I have met during the course of my study. For **most scientists the greatest reward comes from the prospect of their work leading to discoveries which benefit the public** (and from the peer recognition so derived).
>
> "6.2. Scientists' career progression is largely dependent on peer review and the prestige associated with publication. As already mentioned in this report, collaborating with the private sector doesn't always come naturally. The complexities and frustrations of working with the commercial sector can act as a deterrent to commercialisation, particularly if the potential rewards are perceived as being insignificant in comparison with the professional rewards attendant on advancing human knowledge.
>
> "6.3. In order to level the playing field and encourage scientists to overcome the frustrations of collaboration **the Government needs to ensure that the emphasis it now places on knowledge transfer is translated into incentives for scientists to ensure that they are recognised**[,] not just for conducting excellent science but for exploiting it.
>
> "6.4. There is a **broad range of rewards** which PSREs can offer their employees. As well as **highlighting and proclaiming strong performances** internally, PSREs are able to provide **tangible rewards for commercialisation** by recognising it in their promotion processes and by providing financial incentives.
>
> "6.5. Rewarding and incentivising staff to commercialise research should be regarded as an integral part of the process of promoting commercialisation and an entrepreneurial culture. In the private sector and in many of the research council's institutes incentive schemes are now widespread. It should be a requirement for PSRE chief executives that they have in place effective schemes for encouraging and rewarding the participation of scientists in knowledge transfer activities.

"6.6. During the course of my review I found several examples of schemes in which the PSREs **share with scientists the financial income** from commercialisation work. [The full report shows a sliding scale table of financial inducements awarded to S&T staff by an unnamed PSRE.]

"6.7 ...the key features of the scheme have broader applicability. It provides **significant incentives**, even for relatively small commercialisation projects, while ensuring, for highly lucrative commercialisation projects, that there is an incremental incentive for scientists to generate additional profit.

"6.8. Selecting a financial incentive scheme for each PSRE is not straightforward. There is a balance to be struck between on the one hand providing scientists with insufficient reward to encourage knowledge transfer and on the other hand distorting PSRE's behaviour to the detriment of the PSRE's mission or research programme.

"6.9. Central Government has a part to play in this. The Office of Science and Technology's oversight of science expenditure in the UK and its close contacts with the scientific community make it well placed to gather information on the incentive schemes currently operated in Universities, PSREs and the private sector and to develop an understanding of good practice. OST should help to exemplify and promote best practice in providing scientists with incentives for knowledge transfer including in respect of equity and share options.

"6.10. For staff of departmental PSREs, arrangements which offer financial incentives as a reward for commercialisation work can constitute a breach of their conditions of employment. At issue is clause 4.3.8 of the **Civil Service Management Code** which **stipulates that civil servants "must not use information acquired in the course of their work to advance their private financial interests".**

"6.11. The **current interpretation of the code** tends more towards a position that **civil servants must not under any circumstances make profit** from private ventures deriving from their Government work while they remain in its employment. This effectively rules out certain forms of direct participation by serving Government scientists in the commercial exploitation of their research, in particular receiving equity or share options.

"6.12. I believe the **application of the code needs to be revised** in the interests of furthering the Government's objective of encouraging knowledge transfer from PSREs to business. As currently applied, the **code misunderstands the nature of intellectual property** and **perpetuates an inconsistent approach to knowledge transfer across the public sector**."

GERMANY

The issue of employment of scientific, as well as R&D, staff is widely debated in Germany. A significant problem in German science resembles that in Japan. Senior levels of university faculties are filled with tenured personnel who cannot be dismissed with or without cause – such are Germany's labour laws. Canada's man in Berlin, DFAIT's Technology Officer Bruno Wiest, comments: "German academic institutions, and research organizations in general, suffer from the fact that scientific and research and development staff has either the status of civil servants or research employees, and in both cases enjoy a high degree of protection from lay-offs." The result is that recent graduates find 1/ little opportunity to be hired into university faculties, and 2/ small opportunity for advancement within the university system. In recent years, industry has tended to be the preferred choice of German S&T graduates.

A substantial review of an Act, the *Hochshulrahmengesetz* (HRG), which regulates the employment of academic staff at universities, has just passed the Bundesrat, the federal parliament. This review, undertaken largely to assess the situation of Germany's younger S&T workers within the context of German R&D, has just created "a new and much more favorable situation for the employment of junior staff."

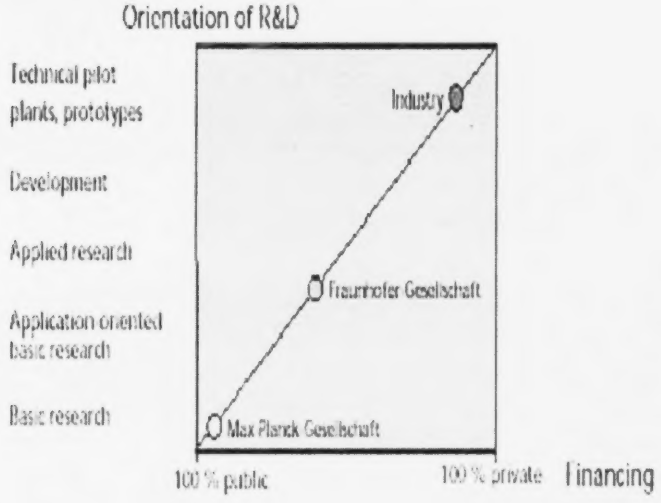
Before examining HR dimensions, it is necessary to show that, **historically, the German situation for R&D has been different** from other industrialized countries. Industry has been the major payer, and the major performer. In 1999, the total German R&D budget was Euros 48 billion. Input and performance were as follows:

FUNDS FROM	INDUSTRY	FED. GOV'T	STATES
	E 31 Billion	E 8.6 Billion	E 7.6 Billion
R&D YIELD	E 32.4 Billion	E 7.9 Billion	E 6.8 Billion

Nearly 70% of German R&D was commissioned, paid for and done, by industry. The performance rating shows that the output of R&D commissioned and performed by industry was more effective than the much smaller sum funded by governments and done in universities and other publicly funded institutions.

Much of German R&D is done by 7,000 S&T employees working in 47 institutes of the Fraunhofer Gesellschaft. Fraunhofer Gmbh is a private-sector company, whose operations are funded by public and private sources, including federal and state governments, and industry. Fraunhofer is, in effect, Germany's default choice for R&D. The following figure shows Fraunhofer's place in the national balance between funding and research functions.

Balance between financing and research orientation



Fraunhofer's institutes are sector-based. Its 7,000 S&T employees work out of one or more of its 47 institutes. It may be that Fraunhofer's continuing success is partly based on the long-standing lack of professional opportunities for young researchers in German universities, a lack currently being addressed by federal legislation.

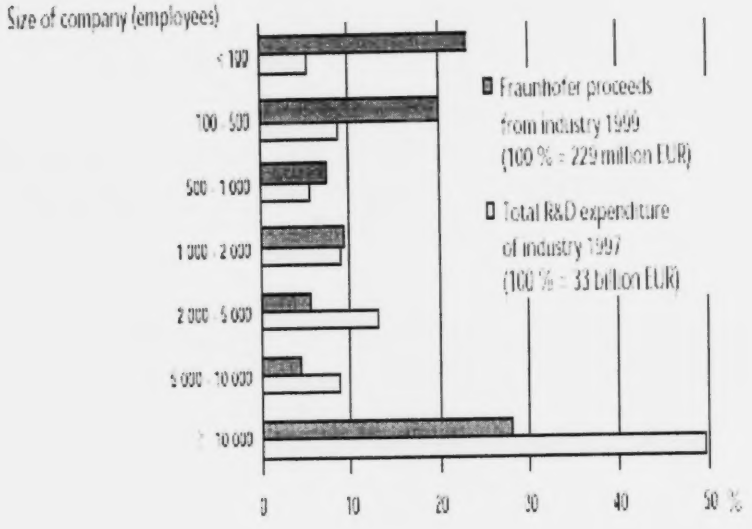
Fraunhofer does R&D on a contract basic, but **the company's 7,000 S&T workers enjoy the benefits of salaried, rather than short-term, positions**. This ensures stability of employment: for example, the leaving rate for women is not statistically higher than for men. There is more mobility than in the university culture, where tenured upper echelons block younger staff.

Respondents to the UK Roberts' Report (cf.) make positive mention of the Fraunhofer work-style several times. The preamble to Roberts' Section 3 states: "Respondents thought that the career path for researchers was often uncertain; it was perceived as **necessary to move into management or marketing roles in order to achieve greater responsibility, and this made the recruitment and retention of scientists and in R&D more difficult**... The need to bridge the gap between university research and corporate development drew comment from many respondents. **Some felt that the Fraunhofer Institutes in Germany provided a good model for closer working and communication**." And, in Section 3.5. "**The Fraunhofer Institutes... offered stable employment** to most of the scientists and engineers they employed. [Many respondents to Roberts] thought that the **Fraunhofer Institutes were a good example of how R&D partnerships between universities and businesses could provide better career opportunities for scientists and engineers**."

Close cooperation between Fraunhofer and small and medium sized enterprises (SMEs) shows how this concept makes R&D available to companies which might not otherwise afford it: R&D

is partly underwritten by government; SMEs get the benefit of leading-edge equipment and personnel; and **Fraunhofer's S&T personnel are assured stable employment, variety in research and interaction with industry**.

Close cooperation between Fraunhofer and small and medium-sized companies



FRANCE

In September 2001, France's Minister of Research, Roger-Gérard Schwartzenberg, announced "Towards a Policy for Scientific Employment." The minister's immediate goal was to create another 500 positions for S&T employees. However, the policy takes matters much further. His mission: "*Il faut rajeunire la recherche pour la renouveler, pour lui donner un nouveau dynamisme. J'entends donc soutenir les jeunes chercheurs et leur donner des perspectives.*" ("We have to rejuvenate research in order to renew it, in order to give it a new dynamism. I intend to support young researchers, looking at this problem from their perspective.") One month later, the minister announced an ambitious ten-year plan (to 2010)[4].

Demographics: The median age of S&T personnel working in France is currently 47. This makes the Ministry of Research's second problem more pressing: the Ministry is finding it difficult to place qualified personnel into the junior and middle echelons of a rigid, hierarchical R&D system (cf. Germany, Japan). The state therefore finds that it is spending valuable funds to educate about 3,000 to 4,000 postdocs each year in S&T fields, only to see them accept short-term contract work or, worse, become "*exil forcé des cerveaux*" – a brain drain, forced into exile, mostly in North America. Systemic difficulties are sufficiently well known that many young graduates make the decision to leave before they graduate.

Reversing the brain drain: The Ministry intends to target S&T graduates now abroad, and attract them home in a reverse brain drain. Therefore, the first two policy points in "*Le Plan Décennal*" are:

- to replace 40% of retiring S&T workers before 2010; and
- to ensure better conditions to employ and retain up to 4,000 postdocs. a year.

These policies are made more urgent because France has only 6.1 S&T workers per thousand of the population, while the US has 8.1, and Japan, 9. Furthermore, the growth in the number of S&T graduates is just 1.2% in France, compared to 2.7% in Britain, 4.6% in Sweden and Holland, and 6.2% in the US.

Structural reforms in R&D: The remaining three points in the Ministry's *Plan Décennal* are:

- structural reforms in the management machinery of public sector labs;
- planning these reforms to support research priorities;
- beefing up public sector research.

[4] *Le plan décennal (2001-2010) de gestion prévisionelle et pluriannuelle de l'emploi scientifique*, Ministère de la recherche, 2001.

This management shake-up is intended to "**do justice to young postdocs, often of outstanding quality, who, unable to find places in sufficient numbers... go abroad**." France's R&D budget grew at about 1.5% in the three years 1998-2000. Budget 2001 saw this figure grow to 2.2%. However, growing the budget matters little without the personnel to do the research. For that reason, France intends to **reform HR departments and hiring policies in public labs**. This means reversing downsizing policies that were in effect until 1997. To paraphrase NASA's Sam Armstrong, "Our public lab hiring skills are atrophied." France's Ministry of Research is saying the same thing.

Budget 2001 created 265 new S&T jobs in public labs. *Le budget civil de recherche et développement 2002* creates 463 jobs, 100 research positions and 363 engineers and technicians. This figure represents a **rise in recruitment for the public lab sector of 5% in 2002. The Ministry hopes to create 1,000 (net) new S&T positions in public sector research by 2004.**

In order **to create more young scientists, the Ministry of Research intends to reform the "face" of public research**, so that research establishments, and their potential recruits, have a more tightly focused view of national research policies and goals. For example, an emphasis on life sciences seems to have caught universities off guard. Faculties in this area have not been renovated or rejuvenated. As a result, there has been a real "stagnation" in the number of students studying life sciences. In an effort **to match graduates with national research priorities, the Plan will make much better use of tracking, and will increase the level of communication between stakeholders and university departments**.

In addition, the Plan intends to **facilitate "mobility" of researchers, in order to "diversify their activities and enrich their competencies."** Sanctioning mobility lets labs diversify their recruiting sources, and to better match researcher competencies with laboratory mandates. In addition, such institutionalized mobility allows for more effective interdisciplinary cooperation and skills transfer. The Ministry has a second motive for making the system more flexible: in areas of "strategic science" it intends to deploy some of the new hires to fill 20% of the jobs left empty by retirees. These measures constitute major HR pillars in the development of the Ministry's evolving "Policy for Scientific Employment."

"In order to attract young people into research"

In addition to creating more jobs in S&T, the Plan provides other inducements. The system by which research funds are allocated is improved. Four thousand students embarking on the first year of a doctoral thesis received funding in years 1996 to 2001. In 2002, that figure has risen to nearly 12,000. In addition, the amount of this stipend (which had not risen in several years) rose in 2002 by 5.5%, to F10,004/month in January, 2002.

The program *Conventions industrielles de formation à la recherche* (CIFRE) lets a graduate student work with a research team in a public lab while developing his or her thesis. 90% of

doctoral students find work commensurate with their thesis in this way. The number benefiting from CIFRE has grown from 1,794 in 1997 to 2,337 in 2002.

Les Actions Concertées Incitatives (ACI)

To encourage young researchers, the Ministry's new ACI program gives a measure of self-direction and personal responsibility in research projects [not unlike the current reforms in Japan]. **ACI is set up to favour "flexibility, initiative and creativity."** The program is limited to projects no longer than three years. The Ministry feels that, until now, approaches taken by young researchers have too often been judged too "traditionally." "Briefly, **ACI is intended to recognize scientific initiative, not conformity."**

ACI stemmed from policy developed by the Interministerial Committee of Scientific and Technical Research (CIRST), with input from the National Council on Science. With this high-level support, ACI is making inroads into the traditional hierarchical research system. For example, postdocs. and those still taking their thesis will be allowed to form their own teams, not only to further their research goals, but to hasten their own promotion into "scientific autonomy." [Again, their is a striking similarity to the Japanese reform.]

This aspect of ACI has a second goal. By putting out calls for proposals (essentially RFPs), ACI hopes to learn what projects excite "young researchers" as distinct from their department heads. The declared object is to "encourage the emergence of new fields, which are less well developed in France; or to identify [and explore] new interdisciplinary fields."

NEW ZEALAND

MINISTRY OF RESEARCH, SCIENCE AND TECHNOLOGY (MORST)
RESPONDENT: LESLEY MIDDLETON, PRINCIPAL ADVISER AT MORST
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Definition: New Zealand uses the term "tertiary education" to include university education and a parallel stream for Maori-specific higher education.

The **demographic** problem exists and is recognized. A study is currently ongoing to set policy and develop initiatives to improve hiring and retention. Currently, MoRST is coping with an acknowledged problem of poor morale at Crown Research Institutes (CRI) (public labs), in spite of the fact that existing staff are highly motivated to work for the good of New Zealand. "This public-service attitude is a valuable asset."

Poor morale an adverse factor in hiring, retention: New Zealand followed the UK's example – indeed, may have gone farther than the UK – by bringing private interests into public institutions, and setting targets for returns to government on invested public funds. As a result, the positive view of CRI staff towards the value of their work is offset by **widespread evidence for poor staff morale**, caused in part by role confusion. In this respect, the morale problem caused by split roles and/or loyalties is not unlike that revealed at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia.

A valuable negative example: New Zealand is valuable in the present report because **it illustrates what *not* to do** in search of best or innovative HR practices regarding S&T workers in the public sector. A recent survey in eight out of nine CRIs shows that morale is poor in nearly every lab, and that distrust of management is common. The report cites several elements:

- Uncertainties created by on-going changes in the science system. Two recent re-engineering efforts have been widely condemned by researchers as threats to their livelihoods. Many CRIs have been put through "successive cycles" of restructuring.
- Clashes between the scientific culture of researchers, and the commercial, profit-driven culture of CRI managers.
- Internal competition within CRIs is set up by the need to meet group revenue targets set by government.
- Personnel at all levels are induced to find new sources of revenue.
- Internal and external reward systems are "misaligned": a clash between scientific excellence versus the application of knowledge.
- Lay-offs and redundancies.
- Low pay and lack of career paths.

Pressure on CRIs to achieve financial targets "underlies all the elements in this list." This approach to CRIs demands that they generate revenue streams. That in turn forces them to focus on large clients who pay well "and [who] attempt to capture as many of the benefits as possible from intellectual property and the commercialization of new technologies." In short, New Zealand, under several governments, has **attempted to treat CRIs as if they were Fraunhofer Institutes (cf.), without making the necessary corporate, structural or HR adjustments** for roles, rewards and recognition (including patent participation)

These are some of the negative HR consequences discovered by the authors of *Making Crown Research Institutes Into More Effective Drivers of Socio-economic Transformation* (2001).[5] The authors conclude that financial targets are being met at the cost of "contribution to Government goals" and "staff morale," among other factors.

Options for Funding Tertiary Research…

… is the title of a recent report for MoRST. While not focused directly on HR, a key point deals with the supply of S&T graduates. For example, tying funding to student numbers in New Zealand universities binds them to "the proclivities of student demand." When the demand for science courses drops, so does funding to science faculties. There is "little certainty of research funding for New Zealand [universities]." The result has been to develop short-term, small-scale projects that are easier to set up [and abandon] than more capital intensive research projects.

"Any method of funding tertiary research must not penalise new and emerging researchers." Early career access to research funding is an issue. New Zealand has introduced "top achiever" and "enterprise scholarships" to complement existing fellowship and postdoctoral schemes within a scheme called "Vote Research, Science and Technology."

Supporting Promising Individuals

Under New Zealand's "Knowledge Goal," MoRST supports awards in six categories to "promising" individuals in research, science and technology. The following categories of award were created in 1999-2000:

- Career Development Awards: support the recruitment, education, training and retention of health researchers (in six sub-categories), providing research training from one to four years.
- Fellowships to researchers "who are leaders in their respective fields."
- Fellowships in ST&E for Maoris specifically, at school and undergraduate levels.
- S&T Post-Doctoral Fellowships.

[5] A study commissioned by MoRST, completed in 2001.

- Science, Math and Technology Fellowships.
- Future Director's Award, to leading science professionals to strengthen their corporate governance skills.

Also contributing to the "Knowledge Goal," the Marsden Fund "is to support researchers in investigator-initiated research exploring the frontiers of new knowledge." Significantly, in New Zealand terms, this research need not be "subject to government's… priorities."

Employment and retention: "A lot of anecdotal evidence indicates that vital fundamental research would not be carried out and, in some cases, **researchers would not conduct their research in NZ, if it were not for the Marsden Fund. This applies especially to people in their early to mid-career period… These people are a vital resource, not only for their contribution to [research] but as teachers and mentors for young researchers."**

Retention: The Marsden Fund (MF) retains skilled New Zealanders by:

- Funding contracts involving 183 principal and associate researchers…
- Tying Marsden Funds to the principal investigator, not an institution.
- Tracking the careers of Marsden Fund recipients.

Investing in "Emerging Researchers"

MF funds employ principal and associate investigators as postdocs and postgraduate students. "The quality of their work, enthusiasm and innovative ideas in Marsden research attracts others to work on complementary projects." Evidence for the **effectiveness of supporting emerging researchers** is shown, as:

- The Marsden Fund collectively employs the largest number of postdocs in NZ.
- 50% of the contracts support postgraduate students – 39 in 2000.
- One third of all investigators completed PhDs less than ten years previously.
- Selection procedures ensure that "emerging" researchers have a fair chance… "

Supporting women in S&T research

In New Zealand, 26% of scientists are women (1996), excluding social sciences. The Marsden Fund has:

- Promoted female researchers' achievement in mass media.
- Maintained gender balance in all MF assessment panels.
- Encouraged women as principal and associate investigators. As a result, the number of female principal investigators rose from 6% in 1995, to 18% in 1999.

Retention

The Marsden Fund encourages interdisciplinary and inter-agency research. Its policy statements express in several ways the notion that variety prevents boredom, helping to keep New Zealand-educated scientists at home.

AUSTRALIA

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION (CSIRO)

RESPONDENT: MR. TONY NIEDERMEIER (Tony.Niedermeier@csiro.au)
A MEMBER OF CSIRO'S CORPORATE HR (CHR)

CSIRO's Corporate HR group has just completed a study on attracting and retaining S&T personnel in CSIRO labs. Tony Niedermeier of CSIRO's Corporate HR Group explained the major points arising from a report completed for CSIRO in May, 2001.[6] The report's conclusions derive from focus groups which "identified what attracted and kept [scientists] with CSIRO and where [CSIRO] might improve our performance [re. hiring, employee satisfaction and retention]." The concept, "employer of choice," refers to "the distinctive organisational attributes which encourage people with relevant skills to join" CSIRO. CSIRO operates 21 Divisions. Staff in these divisions were invited to participate.

Demographic: CSIRO is aware of this problem. "Many organisations in different countries are grappling with similar questions, as knowledge, and people who can apply their knowledge, has become an increasingly important resource for success in the face of intensified competition."

CSIRO Employer of Choice was designed to generate ideas about benefits which employers might offer as extra incentives for people, over and above the more conventional forms of pay, entitlements and conditions, *especially where pay is somewhat less than what might otherwise be on offer…* " [*Emphasis added*.] The study considers the implications of the overall framework of people's work, the working environment and the employment contract (terms and conditions) which affect people's decisions about where they will work and whether they will stay. This encompasses issues such as:

- salary and other benefits
- location of employment
- career structure
- family considerations
- working hours
- development opportunities
- employee and organisational values.

Beyond these issues, a **central theme among respondents was the priority people place on the science** itself, their enjoyment of their work, and the **consequences of ambiguity surrounding prospects of the organisation continuing to support ground-breaking scientific research**, as opposed to commercial research. The study charted paths from hiring, motivating

[6] *CSIRO: Employer of Choice Project, Final Report* was written by a team lead by Dr. Bruce Wilson, of the Union Research Centre on Organisation and Technology.

and retaining S&T employees, and sustaining their job motivation. The lead author of *CSIRO Employer of Choice*, Dr. Bruce Wilson, of The Union Research Centre on Organisation and Technology (URCOT), traced a path from hire+motivate+retain to job satisfaction in S&T employment at CSIRO:

Conditions generating job motivation at CSIRO
(Source: Employer of Choice, page 4)

Wilson found that factors listed in the chart, which are biased slightly towards 1/ Attract and Motivate, or to 2/ Motivate and Retain, produced the most positive outcomes with respect to job satisfaction, motivation, and retention. With respect to retention – "job churn," as some American respondents described it – Wilson found that it cost roughly four times more to continually hunt for and train replacement staff, rather than provide optimal conditions for job satisfaction and motivation of existing personnel.

Wilson found "a remarkable consistency" in views expressed by his "slice groups," no matter where they worked in the CSIRO divisions. Asked why they chose to work at CSIRO, respondents' views – and observations – can be itemized briefly:

- The prospect of doing interesting research; in some cases, researchers returned from overseas to work with leaders they had worked with in their students days.
- More recent hires wanted to be involved in the commercial applications of scientific knowledge, enjoying the engagement with industry and the community.
- The ability to research in a "secure, public sector environment."
- Family, and location, reasons.
- They felt a "significant degree of trust and freedom in setting a research direction, and pursuing excellence." "Quite a few" commented on the importance of their science to the public benefit.
- Training via variety, and "interesting avenues of work" reflected "different trajectories" within CSIRO. Mobility among projects was important.
- CSIRO's lack of "conflict resolution" skills had led some people to leave.
- A significant majority felt that CSIRO's appeal had lessened in recent years. "Current pressures" were cited. The author does not explain what these might be.
- Some commented that CSIRO had "lost its way," especially with respect to the need to bring in "external earnings" from CSIRO's work, and management's ambiguity on this subject. (cf. New Zealand.)
- Everyone agreed that CSIRO should build effective links with industry.
- Confusion about the role of "external earnings" in the acceptance of grant submissions, and overheads deducted by CSIRO's head office.
- The "net effect" left scientists feeling "very anxious" about managing competing pressures, especially when promotion and other career advancement depended more on publication records, rather than earnings.
- Many felt that management takes little notice of their many functions – from administration to research to teaching to mentoring – when evaluating research group performance.
- Researchers felt pressured by a lack of "resources" (unspecified).
- Some complained of worn-out equipment.
- Some complained that mangers took advantage of their dedication to deny overtime.
- Pay was important, for both researchers and support staff. Researchers resented being used by CSIRO as unpaid consultants to external clients.
- Promotion seems to be harder to get, blocking attempts to increase pay.
- Many people, especially women, appreciated the flexible working hours.

Women scientists complained of the male culture of CSIRO's research environment and the "gendered character of relationships." On the other hand, CSIRO lets women manage domestic as well as career responsibilities. Unfortunately, CSIRO's need to change, to become more open to industry, "has increased [women's] sense of vulnerability, and has threatened the very conditions under which they feel able to deliver good science."

Seven factors: The author concluded by noting that seven factors ranked highest across the groups (and across CSIRO), when researchers considered ongoing employment with the organization. Those factors ranked numerically as follows:

1. Being able to do interesting work;
2. Having a degree of autonomy on the job;
3. Pay;
4. Flexibility in working hours;
5. Promotional opportunities;
6. Good relationships with colleagues;
7. Learning opportunities.

Wilson then turned his attention to managers, pointing out that management makes up at least half the satisfaction equation, and suggesting that CSIRO has "scope to develop much better understanding" about how it could assist its managers bring about optimal conditions in the workplace. CSIRO managers should:

- Learn to manage the various expectations;
- Articulate CSIRO's strategic direction and then translate them effectively;
- Design appropriate work systems and work allocation systems;
- Precisely identify the skills required;
- Recruit accordingly;
- Develop and encourage staff learning at all levels;
- Inform and involve staff in consultation in strategic and operation matters.

The *CSIRO Employer of Choice* study suggested several specific proposals for action – "organisational direction," as Wilson put it. These measures were sanctioned by CSIRO's Talent War Task Group:

ORGANISATIONAL DIRECTION
- Determine key goals
- Balance applied and long-term strategic research
- Develop workload templates
RESEARCH MANAGEMENT CAPABILITY
- understand & work with strategic issues
- work processes, technologies & workforce needs
- identify skills & expertise. Recruit accordingly
- communicate/manage expectations appropriately
- appraise performance, provide feedback, ongoing support & learning opportunities
DEVELOPMENT OPPORTUNITIES
-...Development Plans
-...mentoring
- sabbaticals
- team learning
ADDITIONAL BENEFITS
- better promotion opportunities
- sabbaticals
- travel opportunities
RECRUITMENT
- planning ahead for skills/expertise
- advertising for the right people
- recruitment & people management
- innovative recruitment strategies

Specific proposals for action in HR initiatives
developed in CSIRO's Employer of Choice *study* (Introductory page)
with CSIRO's Talent War Task Group.

CANADA

DR PETER SUTHERLAND
DEAN OF SCIENCE (AND ACTING PRESIDENT)
MCMASTER UNIVERSITY

Demographic: Is very much alert to the demographic. As Dean of Science, Sutherland is "hiring like mad." He is hiring from Europe, has lured back Canadians from the States, and has won over the "odd" American. Expects it will get tougher and tougher, but "so far we're okay."

Hiring strategy: Sutherland's main weapon is CFI. "For us, CFI [the Canada Foundation for Innovation] and the match by Ontario Innovative Trust (OIT) are absolutely critical. We have hired several individuals on the expectation that they are going to get from 500K to 800K in start-up funds."

"Without [CFI] we would be dead in the water. In Ontario we are concerned that OIT funding is running out along with the Ontario Research Development Challenge Fund (ORDCF). They are very important to us. We are also using Canada Research Chairs relatively effectively. Those, too, have helped us lure back people to Canada."

Sutherland saw CFI/OIT importance "in the context of a new opportunities fund for hiring new researchers." Equally important are a number of major CFI initiatives: the most recent and important being the Biomolecular Interactions Initiative. McMaster is bringing in very high-end equipment: a 700 MHz nuclear magnetic resonance machine. "No individual researcher could justify that sort of expense. The CFI thrust has changed the landscape for Canadian S&T. The way to do it is to get people to work together on an interdisciplinary area which is completely focused; and then have a reasonable shot at getting serious funding. That's fabulous."

TIME INTERNATIONAL, JANUARY 14, 2002
"THE BRIGHT STUFF:
BRAIN DRAIN OR NOT, CANADA IS TAKING IMPORTANT STEPS TO BE A KNOWLEDGE LEADER"
BY DAVID STRANGWAY, PRESIDENT AND CEO
OF THE CANADA FOUNDATION FOR INNOVATION (CFI).
Strangway's byline in *Time* sets out success stories of six Canadian scientists who chose to stay in Canada, motivated by equipment purchases by CFI. Total CFI expenditures until January 2002: $596 million, awarded to 1,631 projects.

PRECARN ASSOCIATES
AND THE ONTARIO CENTRE FOR RESEARCH AND INNOVATION (OCRI) CONSORTIUM
RESPONDENT: GRAHAM TAYLOR, DIRECTOR, BUSINESS DEVELOPMENT (March 11, 2002)

Building hiring channels: Companies in the OCRI consortium find great value in creating channels for students. Students begin to work for companies at university level, and continue to work for the same companies. The result: "We end up with bright young people staying in Canada." Most of these are graduate students. Very often their supervisors are receiving funding from the OCRI program.

In addition, PRECARN runs the Institute for Robotics and Intelligence Systems (IRIS) network, one of the Networks of Centres of Excellence. PRECARN invites students working in the field of intelligent systems to become members, giving them the right to post their resumes. Taylor sees "potential" there in helping to place students in jobs in Canada. In addition, PRECARN is setting up an HR section on IRIS's web site, where students and employers can post resumes and jobs respectively.

OCRI is not new to the talent pool issue. It has been working in this area since 1990. Its business is to build partnerships to recruit and retain skilled personnel for the Ottawa region. OCRI works to support the strategic priorities of employers, linking them to local educators and students to build the future talent pool.

THE ONTARIO CENTRE FOR RESEARCH AND INNOVATION (OCRI), TALENTWORKS
TALENTWORKS PROJECT EXECUTIVE, NEW PROJECTS AND SPONSORSHIP
CHERYL GORMAN (March 11, 2002)
www. talentworks.ca

Recruitment: OCRI's TalentWorks is active in planning forward recruiting strategies. Having identified seven "economic generator" clusters in the private sector, OCRI identifies their needs and works to fulfil those needs, by:

1/ Drawing S&T employees from the US to Ottawa;
2/ Developing existing employees in order to retain them (this project is currently shelved);
3/ Working with HRDC to capture newly-emerging skills profiles to expedite fast-track immigration. This initiative incorporates three levels of government, the private sector, and "organizations important to the work of economic development." The Treasury Board represents the needs of the federal government in TalentWorks, as a "significant employer in the Ottawa community," including public sector agencies.

TalentWorks brings three perspectives to bear:

1/ Combining general issues and opportunities from an "Ottawa" perspective;
2/ Addressing specific projects: bringing job seekers and employers together;
3/ Employment/opportunities information gathering and dissemination.

VITESSE RESKILLING CANADA INC.
ARVIND CHHATBAR, PRINCIPAL (March 14, 2002)

Vitesse is a not-for profit organization created by the National Research Council, the University of Ottawa and Carleton University, and supported by the Ontario Ministry of Economic Development and Trade's Strategic Skills Initiative, to expand the "successful, award-winning program called O-Vitesse."

Demographics: "With respect to the general premise of your study, the answer is yes, and no. It is true that the demographic bulge is nearing retirement. But it is not true that this poses an insuperable problem."

Reskilling: The Vitesse program started in Ottawa to provide industry with software-engineering resources by Reskilling under-employed or unemployed science and engineering professionals. It expanded to include additional co-op. based individualized training solutions for fields such as photonics, bioinformatics, microelectronics, and wireless communications. Vitesse also offers workplace adjustment and enrichment programs for new and existing knowledge workers, creating a training model built on the premise of a comprehensive skill continuum.

Recruiting/Reskilling – two faces of one challenge: The problem with the traditional approach to **recruiting** is that the basic paradigm is outdated. Technology moves forward so fast that the time-window in which any given person possesses leading edge skills is now shorter than the time it takes to train that person. Currently, an employer looking for a specialist in, say, photonics, advertises for a given skill set: the odds are good that the optimal candidate does not exist. Recruiting strategy based on a job description giving current needs of a particular job are, in fact, not relevant in an emerging knowledge-based situation. Employers should not be looking for people who are state of the science experts in photonics; they should look for someone who can be *transformed* into a photonics expert.

One must look at approaches that allow **recruitment** with a **reskilling** component. Many people are perfectly capable of making substantial transitions. But current recruiting strategies do not recognize this capacity.

It is more important for an employer to hire, based on the knowledge that the chosen candidate has the necessary skills to become a specialist, than to hire the specialist in the first place. This is not a risk. The time it takes for an individual to become acclimatized to an organization is more or less the same length of time needed to give that individual the appropriate training in that particular area. So, corporate acclimatization and reskilling can run parallel. In effect, reskilling does not take extra time. This is a much better way of learning an organization than just being brought in and making contacts with individuals; because, while a new hire is retraining, he or she also learns a specific aspect of the company, integrating the two aspects, the job and the organization.

Recruitment from overseas: The collective effort to import people is based, again, on "current needs." In 1996, Immigration Canada spent months collaborating with employers and academics to reach suitable definitions on what qualifications and specifications were valuable to the national need for software engineers. In retrospect, by the time the specifications were agreed and the appropriate people given fast-track immigration status, industry's needs had shifted. Canada went through the same process in 1989/90 to import civil engineers. On that occasion, the delay resulted in importing the right people at the wrong time, at the start of the recession.

Therefore **recruitment from whatever source should be based on a candidate's basic demonstrated educational attainment**, not on current needs. Canada needs to create a means by which smart individuals go through a barrage of training associated with the immediate needs of industry.

Reskilling – that extra 5% of skills: Many well-*educated* – as opposed to well-*qualified* – people come ready-equipped with a large percentile of basic training. They need only acquire a small percentile of required skills to match current needs. Much of the delay and cost of current recruitment practice is incurred because employers and managers "jump through hoops" trying to find candidates with 100% of current needs skills, while rejecting those with "only" 95%. An enlightened policy would recognize that a large part of the appropriate workforce is walking around with 95% of the basic knowledge, and can be trained to acquire the extra 5%.

The current chase for S&T workers is just another phase in a quest which goes back many decades. Vitesse has studied the trend, and cites cyclical examples. **Governments (and industry) invest when a field has become so "popular" that they need to act. They act in the peak of shortage; by the time new hires come on stream, there is a surplus**. Canada has witnessed this problem twice in a decade: with civil engineers, then software engineers. Universities build new buildings, invest in infrastructure, and hire a faculty to teach subjects for which there will be a surfeit of graduates by the time they are trained. And **when they graduate, they will need to be retrained anyway**. Industry does not think twice about applying this principle to "just in time" production. It is this new paradigm that governments, industries and

universities need to adopt: it is the only approach that lets us move with the times – as fast as the times.

Reskilling solves the retention problem: The retention rate for Vitesse graduates is high, largely because Vitesse does not train people to a full degree level. They gain skills per specific employer demand. The biggest retention problem over the years is based on the fact that when demand for skills peaks, people move from company to company chasing the best salary or working conditions. In such cases, public sector labs will always lose out. However, under a Vitesse-type program, the new skills will not only be specific to the company, but to a specific job at that company. For example, if an employer wants to train an employee in C++, that newly-acquired asset is valuable to that company, but it limits the employee's mobility within the wider field. If, on the other hand, society invests heavily in giving an employee a Master's degree in Computer Science, that person is able to chase the highest salary in a "hot" field. The result: sky-high wages for the fortunate few, high industrial payroll and turnover cost, job churn at high levels and expensive disappointment at the end of a cycle.

Interested parties should do comprehensive cost analysis on the Vitesse-type models to see how this approach to "just in time" retraining could save government, industry and universities the fortunes they are all now spending on recruitment.

Training, demographics and education: Universities were set up to inculcate a standard of empirical learning, so graduates could take on appropriate challenges. State-of-the-art learning in specific skills was not the intention in the past, nor can it be now, because 1/ institutional infrastructure (especially in S&T) cannot keep up with the pace of change, and, 2/ society cannot constantly afford new university infrastructures to meet changing demands. Unfortunately, Canada has no alternative to universities other than community colleges or vocational schools. The **interface between the demands of public sector labs or industry on one hand, and university training on the other no long fits**. Nor, given the speed of change, will it ever fit.

Society needs **an interface structure, whereby labs and industry must be prepared to take on more of the burden of training** in that top 5% or 10% of knowledge that turns a competently educated scientist into a resource to fill a current need.

Human resource planning. Such an approach makes it easier to plan HR supply and demand, because lead times are shorter. We know that by the time society moves to double the supply of specialists in one discipline, the actual demand has moved on. We do not need people and resources being committed to yesterday's need. **If an interface structure takes on that top-end 5% training, then HR planning and retooling will think more clearly, because it will be dealing with a lead time of a year to 18 months, instead of four or five years**.

BIOTECHNOLOGY HUMAN RESOURCE COUNCIL (BHRC)
ELAINE STUART, MANAGER OF PROFESSIONAL DEVELOPMENT (March 17, 2002)

Training and reskilling: The relatively new Biotech industry does not confront a retirement demographic. Instead, Biotech requires new talent as well as reskilled personnel to keep up to the demands of a changing technology. BHRC serves Small and Medium-sized Enterprises (SME) as well as larger companies. E-learning delivers on-line comprehensive course materials to points of demand. This is especially valuable to SMEs, which cannot afford to send employees to workshops or invest in their own education programs.

Course logistics: BHRC is in the finale stages of developing its first two on-line regulatory courses: Introduction to Good Laboratory Practices and Introduction to Good Manufacturing Practices. Both courses run for three months. Participants must dedicate a total of 40+ hours over the three months to complete content, quizzes and assignments. Pre- and post-test elements built into the course let BHRC identify the level of participant learning prior to and after the course.

Adult Learning Spaces: Participants can access on-line courses at times convenient to them. In this respect the courses are very flexible. In many cases on-line learning is an isolated, individual learning experience, but not BHRCs courses. BHRC creates its on-line courses to allow participants to learn not only through course content but through social interactions with one another. Participants are encouraged to utilise the unique features of the course to communicate with one another: through discussion forums, chat rooms and e-mail with their peers and the instructor/facilitator. They must post answers to scenario questions in discussion forums and respond to their peers' responses. They also complete group assignments with peers, using the chat rooms and email features. In addition, scheduled presentations from experts in the field are arranged. The facilitator, guest speaker and participants access the chat room at a preset time, and in real time the quest speaker will talk about a particular topic. Participants type questions or ideas to the speaker and their peers. BHRC courses create a social learning environment in which biotech personnel learn.

BIOTECHNOLOGY HUMAN RESOURCE COUNCIL (BHRC)
NICOLE HEROD, HR RETENTION SPECIALIST (March 12, 2002)

Difficult to recruit and retain: The respondent agrees with the premise that it is difficult for public service labs to recruit and retain skilled workers.

The Council is launching a "Hot-Jobs" survey to find out from member companies the hard-to-fill biotech jobs; and what are the most successful ways companies have been able to fill them in the past. (Responses to this survey should be collated by June, 2002.)

BHRC runs a bio-executive fast-track, a condensed five-day program to give executives what they need to bring their biotech firm to the forefront of the market (in collaboration with the Richard Ivey Business School at Western University, and the Université de Québec).

Retention is the current focus of activity. BHRC is working with the Ottawa company TalentMap.com to conduct on-line employee satisfaction surveys. **TalentMap surveys an organization's members and identifies reasons why employees stay, leave or are thinking of leaving**. TalentMap then reports anonymous findings to management, making recommendations about measures a company might take to retain employees.

BHRC has developed a web site in collaboration with TalentMap, for Pulsekeeper, an employee satisfaction product (www.pulsekeeper.com). This site gives generic information about the product, with special reference to the biotech industry.

Employers are encouraged to share results of a survey with employees, so that everyone sees the results, and the follow-up. This provides company-specific ways to retain people: often the issue is not money. A major factor is often as simple as implementing flex-time (cf. The Software Human Resource Council, Sandia, "The National Security Implications of the Human Capital Crisis," CSIRO). Sometimes the concern is scope of work. The data can be massaged to find the different positive and negative motivators in each division of a company. **That is a very specific tool for retention of S&T workers in the biotech industry**.

Reskilling/rejuvenation: For the future, BHRC is studying some type of mentorship program or service. It is important because it represents a direct in-company transfer of skills as well as employee development. BHRC knows that mentorship is also good for **retention**.

BIOTECHNOLOGY HUMAN RESOURCE COUNCIL (BHRC)
CLAIRE THIFAULT, EXECUTIVE DIRECTOR (April 5, 2002)

The respondent referred the study to BHRC's trade publication, *The Biotech HR Pulse*, (February 7th, 2002), *Retaining Biotech Employees*:

- "Companies blessed with low turnover rates generally have good benefits packages with generous and flexible time-off policies, dependant care leave, flexible work hours – measures that address the issue of life/work balance."
- "[It is] the quality of the work itself and relationships with co-workers that play a large role in determining job satisfaction levels."
- "Organization goals should be aligned with individual goals. Successes and achieved milestones should be celebrated and rewarded."
- "A complex interplay between all these factors [works] systemically to influence a worker's decision to stay with the company or leave.
- There exists a direct link between employee satisfaction and business outcomes.

BHRC has worked with TalentMap.com to create Pulsekeeper, an on-line employee survey program specifically designed for biotechnology and life science companies. Pulsekeeper "assesses in-depth analysis of factors affecting retention as well as benchmark comparisons to other biotech companies."

CARLETON UNIVERSITY, THE SCHOOL OF BUSINESS,
PROFESSOR LINDA DUXBURY
Duxbury is the lead author of "*Under 30 to over 40: How age impacts career development in the High Tech Sector.*"[7] This paper is a summary of "A major study on the career development of knowledge workers in the Canadian high technology sector."

Demographic: The study does not comment on the approaching retirement problem. Rather, it identifies several demographic components in the high technology workforce, and determines the various factors that these groups need to achieve satisfaction. The study surveyed:

- Career goals and aspirations of knowledge workers in the Canadian high technology sector [with respect to age];
- Strategies which employees in this sector use to develop their careers;
- What [employees] perceive that their [employer] has done to help or hinder their career development;

[7] *Best Practices Update, A Newsletter About Building Your Strategic HR Portfolio*, Carswell, Vol. 1, Edition 3, 2001.

- Changes that would make it easier for [people] to meet their career goals;
- The consequences of inaction... *especially with respect to turnover*. [*Italics added*]

With respect to the Under-30 Group, the study suggests that "high technology organizations need to tailor their career development programs and reward structures to the age and career stage of their employees."

Duxbury calls the 30 to 40 Group "The Stressed." Her conclusions are that "Organizations should... "

- Examine pay and total compensation packages to determine if inequities exist... ;
- Include stock options [not applicable to our study];
- Make available a wider variety of formal learning opportunities;
- Establish good policies around learning, education and training;
- Establish an accountability framework to encourage support for such policies;
- Implement policies around work-life balance, by seeing HR policies through a "work-life" lens.

Duxbury calls the "Over Forty" group "The Neglected." **High tech organizations who want to retain** and effectively use the talents of employees over 40 should:

- Develop experiential, on-the-job career enhancement, letting [over-40s] learn from each other;
- Give "older" employees the opportunity to work on high-profile projects;
- Give "older" employees the opportunity to develop specialized expertise and showcase this expertise within the organization;
- Give "older" employees time off to develop their careers. Expecting employees in this group to do this in their own time adds to their stress levels and increases their work-life conflict;
- Give "older" employees the opportunity to mentor younger employees.

THE UNIVERSITY OF REGINA
DR. DAVID BARNARD, PRESIDENT
March 12, 2002

Perception of the HR crisis: In common with many universities and other organizations, the University of Regina was stable in HR terms for many years. "We saw the change coming. Four years ago we started an aggressive early retirement program, giving substantial incentive. 30% of our faculty went within 18 months. We then went on a hiring binge, hiring 50% of the faculty in the last five years." That was a very deliberate, calculated response to the anticipated demographic bulge and dip.

Hiring: Barnard responded that he is seeing more "churn" in this new faculty, largely the result of a shortage of trained people at this level. He reported a "general shortage of doctoral level people in all areas, not just S&T, across Canada." Every university in the country is expecting massive faculty turnovers. "We pre-competed by starting early. We are pleased with the people we have hired. We had a task force internally on recruitment and retention. They didn't come up with any big secrets: we just got on with it more aggressively, and started sooner."

Hiring/retaining: "The good news for us and for the public sector generally is that people are not motivated principally by salary when taking positions." Barnard hastens to add that salary should not be a disincentive. Rather, the University of Regina is trying build an environment conducive to doing work. The university commissioned a study to identify theme areas and concentrate its activity there. He comments that are many reasons to adopt that strategy. One is that his university is "a small institution with not many resources." For that reason it is striving to build an environment that is attractive to people in a smaller number of areas. It lacks the resources to succeed in a general pursuit of excellence across the board. Areas of special academic interest are chosen to align with the realities of Saskatchewan. These, "in alphabetical order," Barnard hastens to add, are:

- Culture and heritage
- **Energy and environment**
- **Informatics**
- Population health
- Social justice

With respect to CSTA'a interest in S&T personnel, the university has a new Petroleum Technology Research Centre (PTRC) looking at extracting heavy oil from underground in Saskatchewan. PTRC is a partnership among the university, the Saskatchewan Research Council, and supported by Natural Resources Canada. The majority of PTRC's board members are in industry, so that the board is well aware of the reality in S&T HR hiring and demand.

PTRC, in common with other high-interest area, is carefully designed to span different areas of traditional academic interest, to pull existing people into its work. The intention is to draw together cross-functional teams. The informatics thrust works the same way: a grant was recently awarded to a group of faculty led by the head of media production studies (formerly film and video): that team includes scientists and engineers as co-investigators. The university's particular set of choices involves **people with an interest in the region's development**. This is one reason why **it has been successful in getting people from very different disciplines to work together – and fostering their interest.**

Hiring: In a cross-disciplinary thrust – such as PTRC and informatics – it is easier and more economical to hire a few key people to mix with appropriate players who are already in place. Thus, hiring becomes a matter of finding key catalysts, rather than all the ingredients. Barnard reminds us of a university president's role: "Presidents who don't bring people together don't accomplish much of anything! What we can do is give incentives for people to work together… You try and shape the environment to produce incentives. I think of it in Einsteinian terms, where you create gravity wells where you'd like people to go, and they go."

Attracting, hiring: As part of creating the right atmosphere to attract people, the university had a significant overhaul of equipment, hardware and infrastructure. "**You can't attract first-rate people to third-rate equipment**." Rather than regarding infrastructure as a one-time cost, the university builds renewal of computing equipment into its base budget. This is partly to recognize the significance of IT in the S&T sector, and partly to attract the right people. This aspect of things (university equipment infrastructure) is "a pressing need across Canada."

Reskilling: It is part of ongoing expectations of people in academia that people should be encouraged to rejuvenate themselves in their sabbatical period. The university has not instituted new programs.